reduced, salmon, and salmon modifier. Sufficient crosses have been made, however, to approximate their positions, which are as follows: reduced, 5.24; salmon modifier, 5.94; salmon, 41.33.

Description of Tables

Table I gives the results of mating the F_1 flies produced by crossing an orange reduced male to a wild type female. All the F_2 females are wild type. Of the F_2 males 850 are wild type, 585 reduced, 785 orange reduced, 586 salmon, 15 orange, and 6 salmon reduced.

Table II gives the F_2 results of mating a salmon male to a wild type female. Of the males 439 were wild type and 382 salmon.

Table III (*a*) and (*b*), gives (*a*) the results of crossing an F_2 reduced male (from an orange reduced male $\times$ a wild female) to a salmon female. The females are wild type and the males salmon. In (*b*) the F_1 wild type females were mated to orange males. The orange males were used instead of the salmon to bring out orange in the females. Orange males and females appear. Hence the F_2 reduced males must have carried the gene for salmon modifier.

Table IV gives the F_2 results of crossing a salmon male to a reduced female. Orange males appear. Hence the reduced line must be homozygous for salmon modifier.

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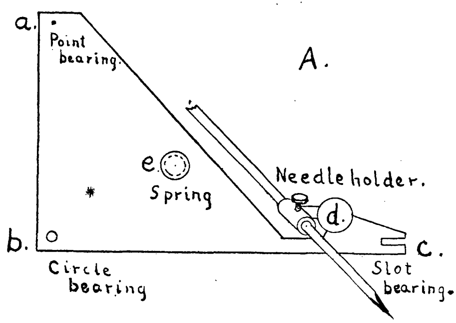
AN APPARATUS FOR MICRODISSECTION

To secure the greatest accuracy in the control of needles for cell dissection an apparatus has been devised on the following plan. The needle is attached to a right angled triangular plate (Fig. *A*), each corner of which is moved by a milled headed screw. The working of any screw causes the movement of the plate about a line through the points of the other two screws as an axis, thus producing motion of the needle point in the three planes of space by manipulation of the screw heads. The nature of the bearings of the screw points on the plate eliminates all side play. The conical end of one screw works into a circular



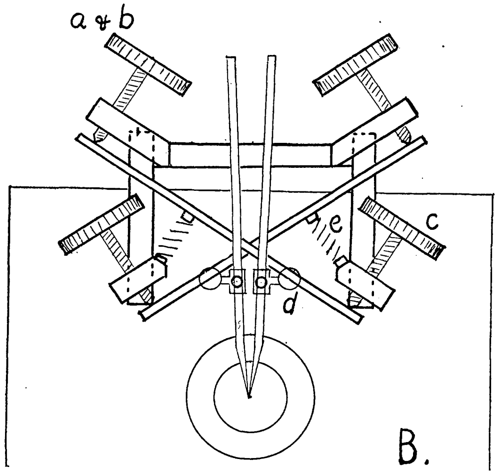


FIG. *A*. Detail of movable plate which bears the needle, illustrating the mechanical principles involved. See text.

FIG. *B*. Diagram of one type of the apparatus clamped to the microscope stage, designed to secure firm needle support close to the microscope focus. The fifth and sixth operating screws are directly beneath two of those figured (*e.g.*, *b* beneath *a*). The vertical movement and one horizontal movement of the needle point are secured by turning one screw each (*a* and *c* respectively); the second horizontal movement, by turning two adjacent screws together (*a* and *b*, with two fingers of one hand). Coarse adjustments are made by moving the needle at the ball-and-socket joint *d*.

hole through a corner of the plate (*b*, Fig. *A*); the conical point of the second screw works into a slit in its corresponding corner (*c*), the third screw point (at *a*) bears on the plane surface of the plate; these constitute what may be termed a cone-slot-point support. The cone-circle bearing prevents side slipping of the plate in any direction; the cone-slot bearing prevents revolution of the plate about the cone-circle bearing. A single spring (*e*)

against the center of the plate holds its bearings firmly against the three screw points, and takes up all lost motion perpendicular to the plate, in the screw threads.

This mechanism has been employed in two styles of dissection apparatus. In one type (Fig. *B*) the aim has been to secure a short needle length, and close proximity of the needle's support to the axis of the microscope lens, with consequent freedom from vibration of the needle and a long leverage in the control of its point. In the other type (Fig. *C*) the apparatus is set away from the microscope axis, to allow the greatest possible freedom of manipulation of objects on the microscope stage. In the former type, the plates bearing the needles cross at right angles, under the microscope nosepiece; in the latter type, they are set beyond the edge of the microscope stage, nearly parallel. Each instrument bears two pipettes or needles operated by three screws apiece. The needles may be attached to the plates either by wax, which when warmed makes possible a coarse adjustment of the needles, or by a universal ball and socket joint, clamped loosely enough to allow gross manipulation under the low power.

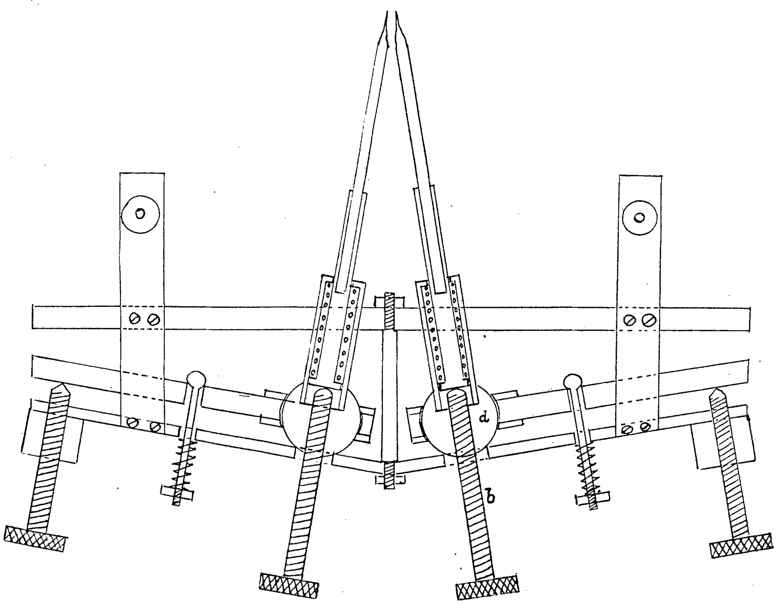


FIG. *C*. Diagram of second type of the apparatus, with parts arranged to leave the microscope stage free for more convenient manipulation of objects upon it. The ball-and-socket joint for coarse adjustment (at *d*) is here made to serve as a pivot in place of the corresponding screw point (*b*); this screw then works through this joint to produce one motion of the needle, thus avoiding the necessity of turning two screws together to secure this movement, as in Fig. *B*.

The advantage of this type of needle control over the sliding motions of the Barber pipette holder lies in greater ease and convenience of manipulation as well as in greater refinement of needle control. The simplicity of the apparatus is such that its manipulation requires no great degree of technical skill, and in its construction have been avoided as far as possible all elaborate and complicated adjustments. The screw heads turn easily enough to be rolled under pressure of one finger each. The complete apparatus for holding two needles may be made to occupy a three-inch cube, and clamped close under the nosepiece; five of its six screws can be operated with one hand, leaving to the other, the mechanical stage ratchets and the sixth needle screw adjacent to these. The needles may be held so close to their points that no vibration is noticeable, especially since no moving part is handled during manipulation. The needle points move in arcs of circles, but since the ratio of length of arc to radius is small, these are virtually straight lines, in the plane of, and perpendicular to the plane of the focus of the objective.

A more detailed account of the working of this instrument, and a description of various devices that may be added to facilitate needle manipulation, will be included in a subsequent paper dealing with the results of its application to the study of protoplasmic activity.

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